REMstar® Pro
REMstar® C-FLEX
REMstar® Pro w/C-FLEX

RESPIRONICS®

Service Manual

A-8-V

RESPIRONICS®

Limited Warranty

Respironics warrants that the REMstar Pro, REMstar Pro with C-Flex, and REMstar C-FLex CPAP device shall be free from defects of workmanship and materials and will perform in accordance with the product specifications for a period of two years from the date of sale by Respironics. If the product fails to perform in accordance with the product specifications, Respironics will repair or replace - at its option - the defective material or part. Respironics will pay customary freight charges from Respironics to the dealer location only. This warranty does not cover damage caused by accident, misuse, abuse, alteration, and other defects not related to materials or workmanship.

Respironics disclaims all liability for economic loss, loss of profits, overhead, or consequential damages which may be claimed to arise from any sale or use of this product. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

This warranty is given in lieu of all other express warranties. In addition, any implied warranty, including any warranty of merchantability or fitness for the particular purpose, is limited to two years. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

The warranty for repairs is ninety days for labor and one year on the part(s) that was replaced.

To exercise your rights under this warranty, contact your local authorized Respironics Inc. 1001 Murry Ridge Lane, Murrysville, Pennsylvania 15668, 1-800-345-6443 (US and Canada only) or 1-724-387-4000.

RESPIRONICS INC.®
1001 Murry Ridge Lane
Murrysville, Pennsylvania
15668-8550 USA

RESPIRONICS®
Deutschland
Gewerbestrasse 17
82211 Herrsching Germany

CE

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Overview: REMstar Pro CPAP System

Warranty	Details the Respironics warranty.
Chapter 1: Introduction	Introduces the REMstar Pro CPAP System.
Chapter 2: Warnings, Cautions, and Notes	Lists the Warnings, Cautions, and Notes.
Chapter 3: Specifications, Features, Descriptions, and Theory of Operation	Describes the theory of operation for the REMstar Pro CPAP System including basic operations of the subsystems.
Chapter 4: System Setup Procedures	Details system setup, including instructions on the Therapy Menu Display Screens and Required, Alternate, and Optional Patient Accessories.
Chapter 5: Routine Maintenance	Provides cleaning and routine maintenance instructions.
Chapter 6: Troubleshooting and Diagnostics	Provides troubleshooting flow charts and error code definitions.
Chapter 7: Repair and Replacement	Describes detailed procedures of removing and installing all major components within the unit, including graphics and photographs for visual identification.
Chapter 8: Testing	Includes Run-In, Pressure and Flow Calibration, CPAP Final Test, Heated Humidifier Test, Current Draw Test and Data Sheet.
Appendix A: Tools and Equipment	Details the necessary tools and test equipment required for servicing.
Appendix B: Schematics	Provides Printed Circuit Assembly (PCA) schematics.

NOTE: Schematics are proprietary and are used for reference only.

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Chapter 1: Introduction

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Chapter 1: Introduction

1.1 REMstar Pro CPAP System Overview

The REMstar Pro, REMstar Pro with C-Flex, and REMstar C-Flex CPAP system shown in Figure 1-1, is a microprocessor-controlled device that delivers Continious Positive Airway Pressure (CPAP) therapy only for the treatment of adult Obstructive Sleep Apnea (OSA). CPAP provides a constant level of positive pressure throughout the breathing cycle to pneumatically splint the airway open. C-Flex therapy is also available on some models of the device. In these devices, CPAP therapy is improved by providing pressure relief when the patient exhales. The pressure relief lowers the device pressure slightly during the patient's exhalation to improve the comfort of the device.

The unit incorporates a user interface made up of a Liquid Crystal Display (LCD), five tactile feedback user control keys and three Light-Emitting Diodes (LED's). The LED's may be used as either system alert/alarm indicators and as back lighting for the user interface control keys. The unit may be operated using either AC (100 - 240 VAC) or DC (11.5 - 14.5 VDC) power.

Warning: DC power can be used only when the REMstar Pro is used independently of the Heated Humidifier.

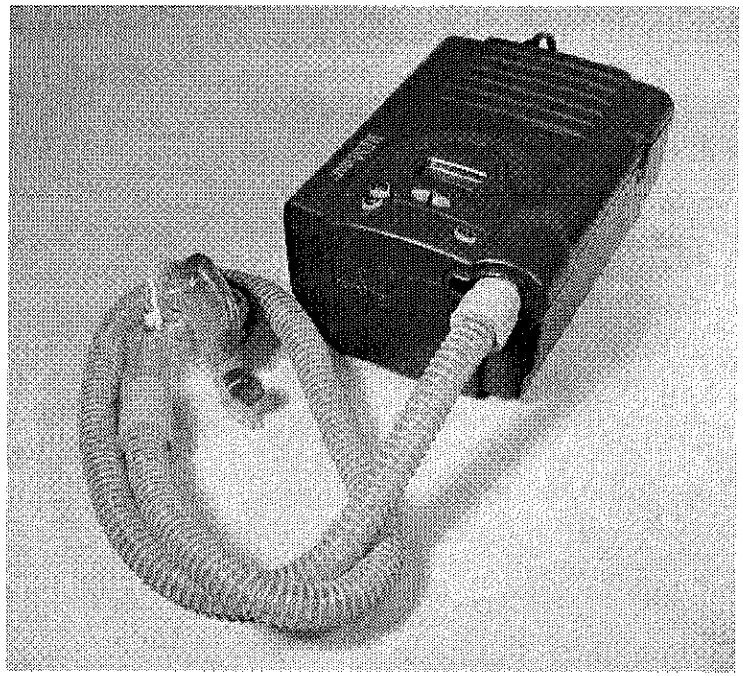

Figure 1-1
REMstar Pro CPAP System

1.2 Service Notice

This service manual was prepared by Respironics primarily for use by technicians to service the REMstar Pro CPAP System with the following Model No.

1005961	1006169
1010220	1010924
1011079	1006171
1012257	JP1006171
AU1006171	LA1006171

The individuals using this manual to service the REMstar Pro CPAP System should have prior training or experience servicing ventilatory devices.

1.3 Technical Support Statement

Respironics is committed to customer satisfaction and may be contacted with any questions or for technical support. For technical assistance or replacement part ordering information contact Respironics Customer Satisfaction.

U.S. and Canada

Phone:1-800-345-6443
Fax 1-800-886-0245

International

Phone 1-724-387-4000
Fax: 1-724-387-5012

Visit Respironics Home Page on the World Wide Web at:

www.respironics.com

service@respironics.com

Chapter 2: Warnings, Cautions, and Notes

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Notes

Chapter 2: Warnings, Cautions, and Notes

WARNING:	Indicates the possibility of injury to the patient, operator, or technician.
CAUTION:	Indicates the possibility of damage to the device.
NOTE:	Places emphasis on an operating characteristic.

2.1 WARNINGS

2.1.1 Safety

- This device is intended for adult use only.
- This device is not intended for life support or life sustaining applications.
- The instructions in this manual are not intended to supersede established medical protocols.

2.1.2 Operational

- This warning applies to most Continuous Positive Airway Pressure (CPAP) devices. At low CPAP pressures, the air flow through the exhalation port may not be enough to clear all of the exhaled gas (CO_2) from the mask. You may breathe in some of the air that you have exhaled.
- If oxygen is used with this device, the oxygen flow must be turned off when the device is turned off. If the device's air flow is turned off and the oxygen flow is left on, oxygen may accumulate in the REMstar Pro CPAP System enclosure and may create a risk of fire. This warning applies to most types of CPAP devices.
- When supplemental oxygen is used at a fixed flow rate, inhaled oxygen concentrations will vary depending on pressure settings, patient breathing patterns, mask selection and leak rate.

Warnings (Continued)

- Oxygen supports combustion. Do not use oxygen in the presence of open flames, cigarette smoke, electrical spark, or other sources of ignition.
- Device is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
- In situations where risk of contamination between the user and the device is high (e.g.: sleep lab devices; rental devices; users with respiratory infections), a low-resistance, main flow bacteria filter should be placed in-line between this device and the circuit.
- Most CPAP devices have the potential to induce rebreathing of exhaled air. To reduce this potential, use only Respironics circuit accessories, do not wear the mask and headgear for more than a few minutes while the unit is not operating, and do not block or try to seal the vent holes in the exhalation port.

2.1.3 Service

- Electronic components used in this device are subject to damage from static electricity. Repairs made to this device must be performed only in an antistatic, Electro-Static Discharge (ESD) protected environment.
- To assure the safety of the service technician and the specified performance of the device, Respironics recommends that only technicians having prior training or experience servicing ventilatory devices perform any repairs or adjustments to the REMstar Pro CPAP System.
- High voltages are present inside this device. To avoid electrical shock, disconnect the electrical supply before attempting any repairs on the device.

2.1.4 Cleaning

- To avoid electrical shock, disconnect the electrical supply before cleaning the REMstar Pro CPAP System. DO NOT immerse this device into any fluids.

2.2 CAUTIONS

- Federal law (U.S.) restricts this device to sale by, or on the order of a physician.
- Care should be taken to avoid exposure of the REMstar Pro CPAP System to temperatures at or near the extremes of those specified in Chapter 3. If exposure to such temperatures has occurred, the device should be allowed to return to room temperature before being turned on.
- Always use an intake filter when the REMstar Pro CPAP System is in use.
- Never place liquids on or near the REMstar Pro CPAP System.
- Discontinue using this device if any of the parts are damaged. Replace any damaged parts before continuing use.
- The information in this manual is provided for service personnel reference and is not intended for system setup or use. System setup should be performed by appropriate personnel using Home Care Dealer Instructions.

2.3 NOTES

- Refer to the REMstar Pro CPAP System Manuals for product use additional warnings, cautions, and notes.

Additional WARNINGS, CAUTIONS, and NOTES are located throughout this manual.

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Chapter 3: Specifications, Features, Description, and Theory of Operation

3.1 Overview

This chapter describes the REMstar Pro CPAP System specifications and system features, and provides a functional description and theory of operation.

3.2 Specifications

3.2.1 CPAP Specifications

ENVIRONMENTAL:

Operating Temperature	41 to 95°F (5 to 35°C)
Storage Temperature	-4 to 140°F (-20 to 60°C)
Humidity (Operating / Storage)	15 to 95% non-condensing

NOTE: The outlet temperature rise can be as much as 18°F (10°C) higher than room temperature measured at the end of a 6 ft. tube.

Atmospheric Pressure	76.7 to 102 kPascals
Elevation	0 to 5500 ft.
Noise Level	No specification is given because various instruments, test procedures and unit operating conditions produce varying results.

FUSES:

Fuses	There are no replaceable fuses.

PHYSICAL:

Dimensions	9 1/2″ x 6 7/8″ x 4 1/2″ 24 cm x 17 cm x 12 cm
Weight	< 4 lbs. (1.8 kg)

ELECTRICAL:

AC Input Voltage	100 - 240 VAC ± 10% 47 - 63 Hz
DC Voltage	11.5 - 14.5 VDC
AC Current Consumption	1.0 A maximum
DC Current Consumption	3.0 A maximum
Power Consumption	80 VA maximum
Type of Protection Against Electrical Shock	Class II Equipment 2-prong AC power inlet
Degree of Protection Against Electrical Shock	Type BF Applied Part

Specifications (Continued)

Degree of Protection Against Ingress of Water	IPX0-Ordinary Equipment
Degree of Safety of Application in the Presence of a Flammable Anaesthetic Mixture with Air, Oxygen, or Nitrous Oxide.	Equipment not suitable for use in the Presence of a Flammable Anaesthetic Mixture with Air, Oxygen, or Nitrous Oxide.
Mode of Operation	Continuous

STANDARDS COMPLIANCE:

This product complies with the requirements found in the following standards.

IEC 60601-1	General Requirements for Safety of Medical Electrical Equipment
EN ISO 17510-1	Sleep Apnea Breathing Therapy Devices

FUNCTIONS:

Modes	Provider Mode
	User Mode
	Diagnostic Mode
	Humidifier Operation

RAMP:

Minimum Ramp Press	4.0cm H_2O to current CPAP setting
Ramp Resolution	.2 cm H_20
Ramp Time	5 to 45 minutes
Ramp Time Resolution	5 minute increments

ALTITUDE COMPENSATION:

Pressure Range	77 to 102 kPascals
	Automatic Altitude Adjustment

COMPLIANCE METER:

Compliance Meter (LCD)	Total Operation Time
	Therapy Time
	Percent Memory Remaining

COMFORT SETTING:

Therapy Type	C-Flex (Only available on REMstar Pro with C-Flex and REMstar C-Flex.)
	CPAP

Specifications (Continued)

PRESSURE:

AC Operation	4 - 20 cm H_2O
DC Operation	4 - 20 cm H_2O
CPAP Mode	4 - 20 cm H_2O
Resolution	.2 cm H_2O

NOTE: Pressure accuracy measurements shall be taken at the end of a six foot patient circuit with a Whisper Swivel II exhalation port.

Static Pressure Accuracy	+/- 1 cm H_2O of the displayed pressure setting
Pressure Drop with Humidifier	.3 cm H_2O @ 20 cm H_2O

THERAPY MEMORY:

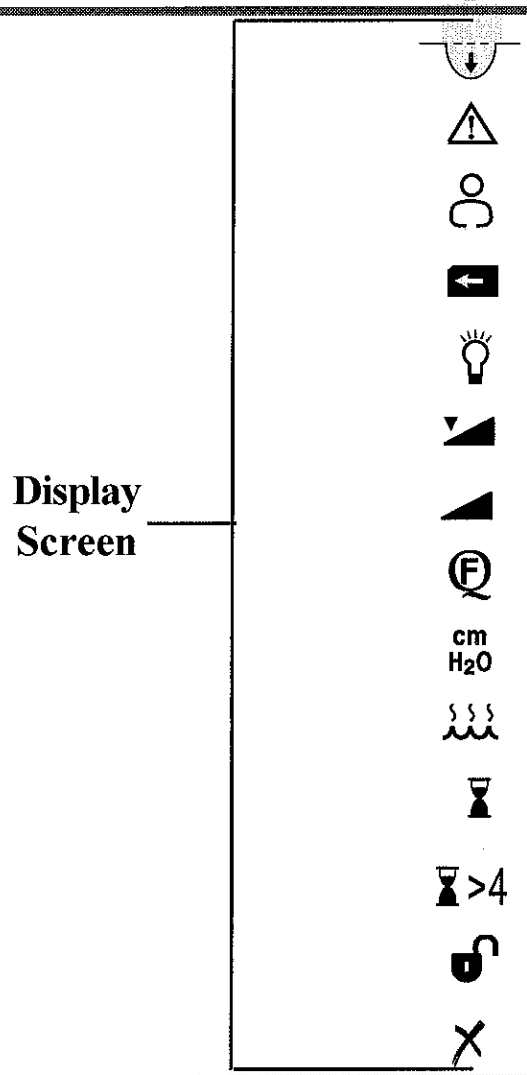
Therapy Memory	Retrievable by Encore Software (version 3.0 or later)

STORAGE:

Data Storage	Data storage shall be on a removable contact SmartCard.
Max Capacity	6 months of data comprised of 3 sessions per 24-hour period, with 2.5 ramps per session.
Content	Separate memory areas for prescription information and data storage.

3.3 System Features

AC Power Connector	Connect AC power here.
DC Power Connector	Optional DC Power Connection for CPAP
Air Outlet Port	Connect flexible tubing here.
LCD Display	Displays all system settings, blower hours, and sessions > 4 hours. Display will show icons for international units and english words for domestic units.
Filter Cap & Filter	The pollen filter screens out normal household dust and pollens. This must be in place at all times when operating the REMstar Pro CPAP System.
Pressure On / Off Button	This button turns the air flow on or off. DO NOT turn the air flow on until the circuit tubing is connected.
Ramp Button	This button decreases the pressure to the minimum ramp pressure setting.
Heated Humidifier Button	Use this button only when the optional Heated Humidifier is connected. Follow the instructions included with the humidifier.
User Buttons	These buttons can be used to change some of the device settings.



Display Screen	Meanings
	C-FLex Symbol
	Attention is needed
	Patient disconnect activated/enabled
	SmartCard is installed
	Button lights are ON
	Ramp start pressure
	Ramp pressure is being delivered
	FOSQ test questions are shown
cm H_2O	Centimeters of water
	Humidifier is ON
	Hours of use
>4	Number of nights with more than 4 hours usage
	Therapy setup menu
	Settings are being erased

Control Buttons	Meanings
	Pressure Start / Stop
	Ramp start
	Humidifier On / Off

REMstar Pro Labels	Meanings
	Attention, consult accompanying documents
	DC Power
	AC Power
	Type BF Applied Part
	Class II (Double insulated)
IPX0	Ordinary Equipment Rating
	European CE Declaration of Conformity
	Notified Body Approval for Standards Compliance
	Canadian / US Certification

3.4 Functional Description

The REMstar Pro CPAP System is a microprocessor controlled Continuous Positive Airway Pressure (CPAP) device that will produce positive pressure.

The REMstar Pro CPAP System operates in straight CPAP mode. The REMstar C-Flex and the REMstar Pro with C-Flex will operate in straight CPAP mode, or CPAP with the comfort setting of C-Flex as determined by the provider. The pressure range in AC and DC operation is: 4.0 - 20.0 cm H_2O.

Integral to the generation of air flow is the blower assembly. Ambient air is drawn through the air intake filter, and pressurized by the energized blower. Ultimately, therapeutic pressure is provided to the patient via the patient circuit. The microprocessor regulates the motor speed, which in turn adjusts and controls the pressure.

The REMstar Pro CPAP System may be powered from either AC (100 - 240 VAC) or from DC (11.5 - 14.5 VDC). AC power enters the unit via an AC inlet and appropriate power cord. A DC power cord connector enables the patient to use the system when AC voltage is not accessible.

The system filter, ensures optimum operation for the user. An air outlet port and pressure port allows for connection to the patient circuit.

The patient circuit is made up of flexible tubing, exhalation port, and nasal mask. The unit applies CPAP to the patient's upper airway to keep the airway open during sleep. Air flow generated from the unit is directed to the patient via a mask and flexible tubing that connects to the air outlet port of the unit.

The ramp feature, lets the user reduce the pressure from the REMstar Pro CPAP System so the patient can fall a sleep at a lower, more comfortable pressure at any time or as many times as needed during the night.

The REMstar Pro CPAP System is intended to deliver CPAP therapy only. It is not intended for life support or life sustaining applications. The following sections describe the major components of the REMstar Pro CPAP System and their basic theory of operation.

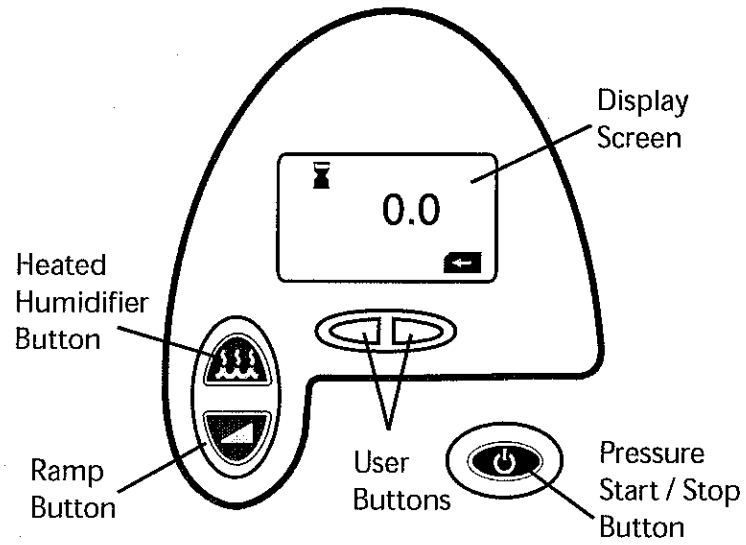


Figure 3-1
User Buttons

3.5 Theory of Operation

3.5.1 Control Pad & Liquid Crystal Display (LCD)

The control pad consists of five user buttons (Ramp Button, On / Off button, Heated Humidifier Button, and Right and Left User Buttons for other functions). The On / Off button activates and deactivates the pressure. The range of pressure is 4.0 to 20.0 cm H_2O with AC and DC operation. The Ramp Button initiates a ramp cycle which incrementally and automatically increases the pressure. The Ramp begins at the set ramp pressure, and over the specified time period, increases until the therapeutic pressure is reached. Ramp Time is adjustable from 0 to 45 minutes in five minute increments (0 would be off). An LCD is used to show various operating parameters while the unit is powered. LCD will show icons on international units and English text on domestic units.

3.5.2 Main Printed Circuit Assembly (Main PCA)

The Main PCA is the control center of the REMstar Pro CPAP System. The Main PCA utilizes a microcontroller chip which reads from and writes to various I/O devices (control pad, LCD, memory, pressure sensor, flow sensor, motor control circuitry, RS-232 interface, etc..) With all of this information, the microcontroller makes appropriate decisions so the blower is properly controlled to deliver the desired CPAP therapy in a safe and reliable manner.

The microcontroller and the interface circuitry provide closed loop control of the blower motor's speed. The blower motor is a three phase brushless DC motor with permanent magent rotor, stationary coils that are connected in a "Y" configuration and serve as its stator coils, and a Hall-Effect sensor to detect the motion of the rotor. Proper timing and sequencing of the stator switching is provided by the microcontroller which senses the motor's shaft position by monitoring a Hall-Effect sensor within the motor.

The microcontroller also sets the motor speed (and consequently the output pressure) by varying the voltage which is delivered to the motor. It does this by controlling the pulse width of commutation signals.

The unit has a switching power supply which is built on the Main PCA and mounted within the unit's top enclosure. The switching power supply operates properly on any AC voltage between 100 - 240 VAC; 47 - 63 HZ and produces an output of approximately 16 VDC. The switching power supply automatically adjusts for varing input voltages. No voltage selector switch or fuse changing is required, which allows for worldwide operation.

3.5.3 Encore SmartCard

The REMstar Pro CPAP is delivered with the Encore SmartCard installed. The SmartCard is a plastic card similar in size and shape to your normal credit card. But instead of holding information on a magnetic strip, it holds it in a small silicon chip embedded into the card.

When installed into the REMstar Pro CPAP System, the SmartCard records the date, time at pressure, pressure levels, and duration of each use. Using the Encore Software (version 3.0 or higher), the usage data can be downloaded and viewed.

The SmartCard can also be programmed with the patient's prescription by using the Encore Software and SmartCard reader/writer. When the programmed SmartCard is inserted into the device, the prescription settings are automatically transferred into the device and erased from the SmartCard. The SmartCard will then start to collect patient data.

Chapter 4: System Setup Procedures

4.1 Overview 4-3

4.2 REMstar Pro CPAP System System Setup 4-4

4.3 Recommended, Alternate, and Optional Circuit Accessories 4-9

Notes:

Chapter 4: System Setup Procedures

4.1 Overview

This section provides an overview of the system setup including detailed instructions on the therapy menu display screens. Refer to Chapter 7, Repair and Replacement, or Chapter 5, Routine Maintenance, for filter and filter cap installation instructions.

NOTE: The LCD will display icons for international units and English text for domestic units.

4.2 CPAP System Setup

Step 1 Plug the male end of the AC power cord into an electric outlet.

Step 2 Simultaneously, press the two User buttons (below the display screen) then plug the female end of the AC power cord into the AC inlet on the back of the REMstar Pro CPAP System. Continue to hold the two buttons down until the unit beeps twice (see Figure 4-1).

NOTE: If a System Error 8 "key stuck" occurs, repeat the process in Step 2 again.

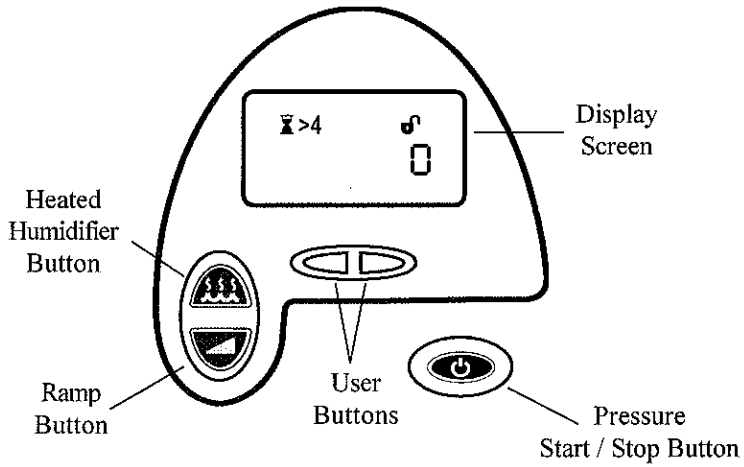


Figure 4-1
Touchpad Features

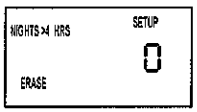
Figure 4-2
Connecting and Entering the Therapy Mode

4.2.1 Display Screens

NOTE:	You cannot turn the air flow on when you are in the Therapy Setup menu. When you exit this menu, the Therapy Time will be displayed.
NOTE:	During system setup, press the left or right User button to view a setting. Press the humidifier or ramp button to change the setting.
NOTE:	Display screens are dependent on features of international or domestic models.

Step 1 Erase the Therapy Hours

The number of nights the REMstar Pro was used for therapy for more than 4 hours will appear. Press and hold the ramp or humidifier button until the erase icon disappears to delete the therapy hours. Press the right user button to continue to the next setting.



Domestic Screen

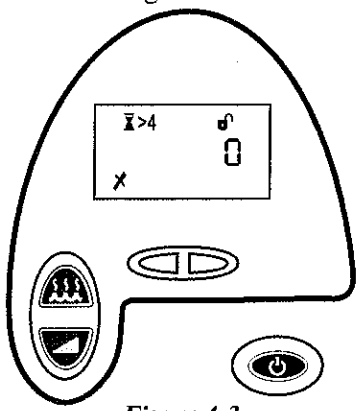


Figure 4-3
Erasing the Therapy Hours

Step 2 Comfort Selection

The REMstar Pro with C-Flex and the REMstar C-Flex can be placed in the CPAP setting which provides a constant level of positive pressure throughout the breathing cycle or it can be placed in the C-Flex setting which provides the user with an adjustable pressure relief during exhalation. Pressing the ramp or humidifier buttons will toggle between the two settings. Choose the desired setting and press the right user button to continue to the next setting.

Domestic Screen

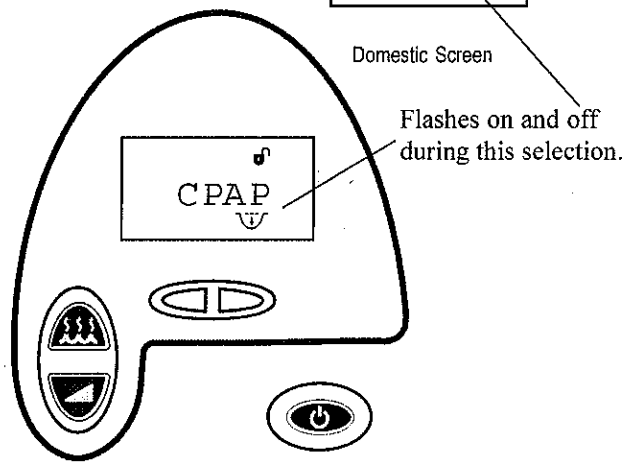


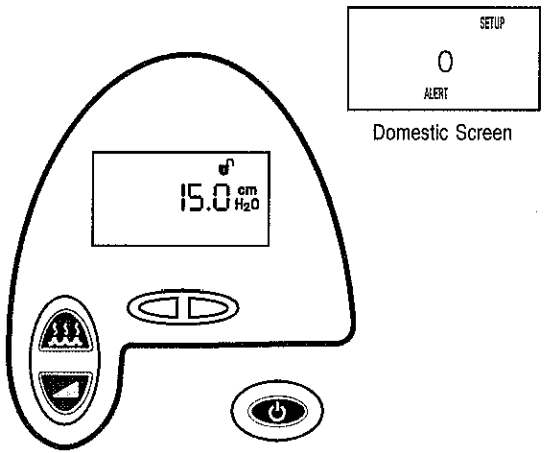
Figure 4-4
Setting the Mode

System Setup (Continued)

Step 3 Setting the Pressure

The CPAP pressure setting will be displayed. Press the ramp button or the humidifier button to select the proper pressure. Press the right user button to continue to the next setting.

Range: 4 - 20 cm H_2O
.2 cm H_2O increments



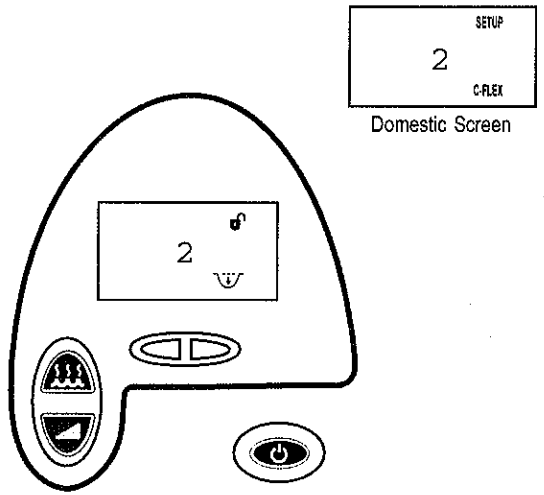
Domestic Screen

Figure 4-5
Setting the Pressure

Step 4 Setting the Comfort Setting

NOTE: This setting will only appear on units with C-Flex. The comfort setting will only be displayed if the C-Flex feature was enabled in Step 2.

The comfort setting will be displayed. Press the ramp button or the humidifier button to select 1-3. Press the right user button to continue to the next setting.



Domestic Screen

Figure 4-6
Setting the Comfort Setting

Step 5 Setting the Ramp Time

The ramp time will be displayed. Press the ramp button or the humidifier button to select the proper setting. Press the right user button to continue to the next setting.

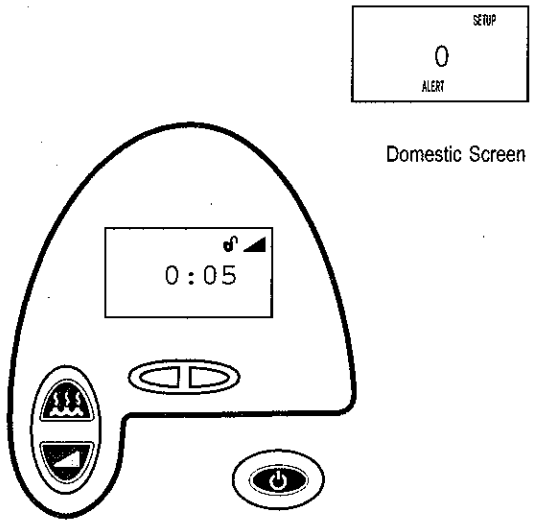


Figure 4-7
Setting the Ramp Time

Step 6 Setting the Minimum Ramp Pressure

The ramp pressure will be displayed. Press the ramp button or the humidifier button to select the proper setting. Press the right user button to continue to the next setting.

Range: 4.0 - 20.0 cm H_2O
.2 cm H_2O increments

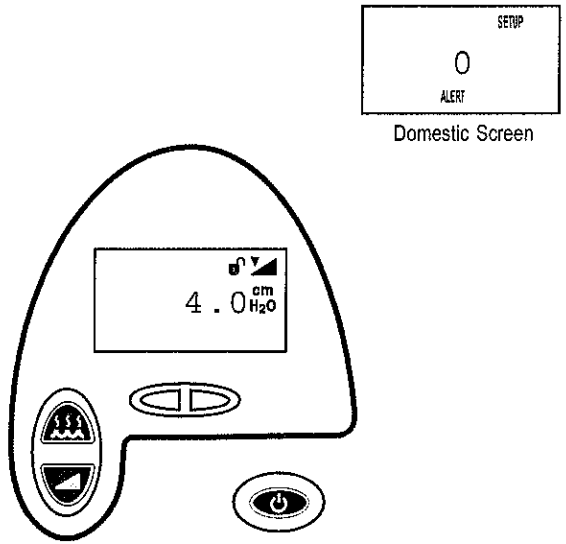


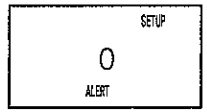
Figure 4-8
Setting the Minimum Ramp Pressure

System Setup (Continued)

Step 7 Set the Mask Alert

The mask alert setting will be displayed. Press the ramp button or the humidifier button to select the proper setting. Press the right user button to continue to the next setting.

Selection: 0 - Off
1 - On



Domestic Screen

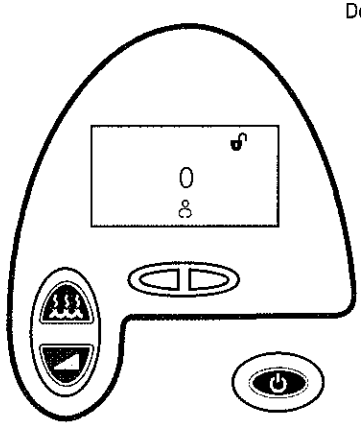
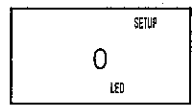


Figure 4-9
Setting the Mask Alert

Step 8 Set the Button Lights

This setting allows the lights behind the buttons to be on or off when the airflow is turned on. Press the ramp button or the humidifier button to select the proper setting. Pressing the right user button will bring you back to the first set up screen. Pressing the Start / Stop button will take you out of the set-up menu.

Selection: 0 - Off
1 - On



Domestic Screen

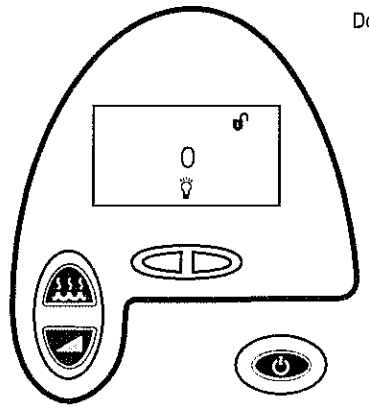


Figure 4-10
Setting the Button Lights

4.3 Recommended, Alternate, and Optional Circuit Accessories

This section addresses the recommended, alternate, and optional circuit accessories that can be used with the REMstar Pro CPAP System. For additional information, refer to the User's Manual or the Home Care Providers Manual or the literature supplied with accessory.

4.3.1 Recommended Accessories

To use the REMstar Pro CPAP System, the following accessories are recommended in order to assemble the circuit.

WARNING: If using the REMstar Pro CPAP System with other patient circuits than the recommended patient circuit identified below, pressures should be verified before use.

Recommended Patient Circuit

- Respironics Nasal Mask with integrated Exhalation Port (or Respironics mask with separate exhalation port such as the Whisper Swivel*).
- Respironics 6 ft. (1.83 m) Flexible Tubing.
- Respironics Headgear or Softcap (not shown).

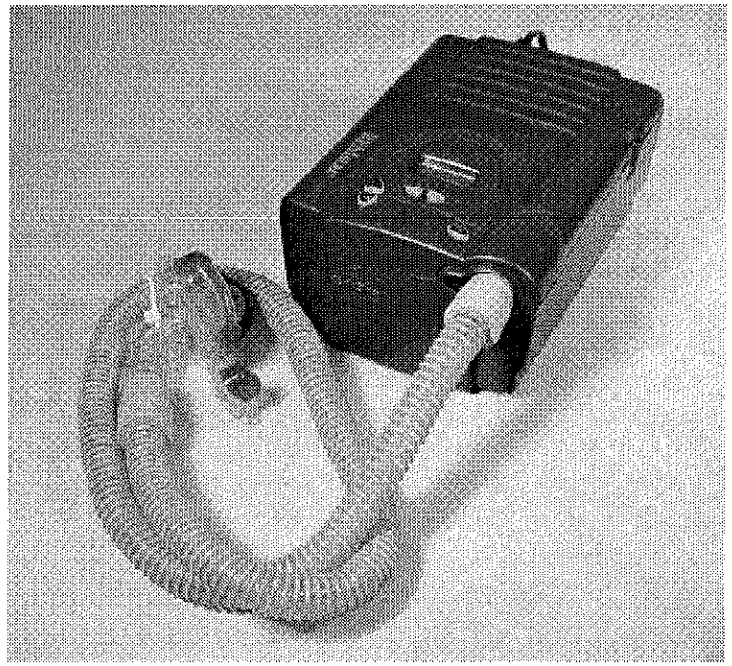


Figure 4-11
REMstar Pro CPAP System with Recommended Circuit

4.3.2 Alternate and Optional Circuit Accessories

The Respironics alternate accessories listed in Table 4-1 can be used in place of the recommended accessories. The optional accessories can be added to the patient circuit. Refer to Table 4-1 for changes in the pressure / flow characteristics when using these accessories.

Table 4-1, Patient Circuit Accessory Pressure / Flow Characteristics

	Pressure Drop @ 30 lpm (cm H_2O)	Pressure Drop @ 60 lpm (cm H_2O)
Recommended Patient Circuit		
Nasal Mask (disposable, reusable)	0.03	0.09
Profile Lite Nasal Mask (reusable)	0.03	0.09
Simplicity Mask	0.20	0.77
Whisper Swivel II (reusable)	0.02	0.08
6 ft. (1.83m) Flexible Tubing	0.11	0.30
Alternate Accessories		
Spectrum Full Face Mask	0.04	0.10
Plateau Exhalation Valve (reusable)	0.05	0.20
6 ft. Disposable Circuit & Exhalation Port	0.20	0.34
Optional Accessories		
REMstar Passover Humidifier	0.00	0.30
REMstar Heated Humidifier	0.00	0.30
King Bacteria Filter (disposable)	0.74	1.65

WARNING! Appropriate diagnostic pressures must be determined when alternate or optional accessories are in place. Respironics reusable circuit accessories are washable but are for single patient use only. They are not intended to be used on multiple patients.

Recommended, Alternate, and Optional Circuit Accessories (Continued)

The following graph provides the exhaust / flow characteristics of the exhalation port accessories that can be used with the REMstar Pro CPAP System. This information may help assess the CO_2 rebreathing potential of various circuit configurations at different applied pressures.

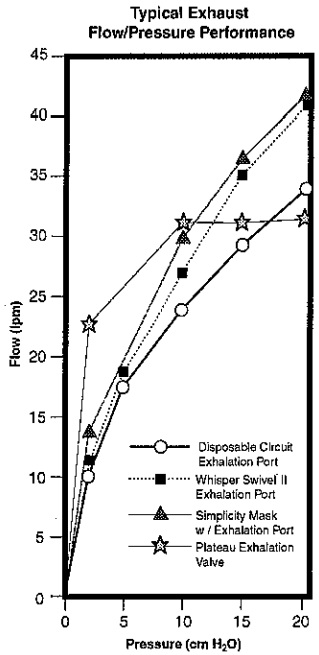


Figure 4-12
Typical Exhaust Flow / Pressure Performance

WARNING: Appropriate diagnostic pressures must be determined when alternate or optional accessories are in place. Respironics reusable circuit accessories are washable, but are for single patient use only. They are not intended to be used on multiple patients.

4.3.3 DC Power Accessories

The Respironics Shielded DC Power Cord (RI P/N 1001956) can be used to operate the REMstar Pro CPAP System in a stationary recreational vehicle, boat, or motor home.

The Respironics DC Battery Adapter Cable (RI P/N 532209) when used with the Respironics Shielded DC Power Cord enables the Respironics CPAP System to be operated from a 12 VDC freestanding battery.

NOTE: Respironics recommends a 100 amp-hour deep cycle marine battery.

The REMstar Pro CPAP System should not be operated while the vehicle is in motion.

CAUTION: Only use the Respironics DC Power Accessories. Use of any other system may cause damage to the REMstar Pro CPAP System or your vehicle.

CAUTION: DC Power is not intended to be used as battery backup. DO NOT connect the DC Power while the REMstar Pro CPAP System with is operating on AC Power. System damage may occur.

CAUTION: DC power can be used when the CPAP and Heated Humidifier are connected together as a system. However the Heated Humidifier will not function on DC power, however it will function as a cold passover humidifier.

4.3.4 Adding Oxygen to the System

Please note the warnings listed below when using oxygen with the REMstar Pro CPAP System.

WARNING: When using oxygen with the REMstar Pro CPAP System, turn the unit on before turning the oxygen on. Turn the oxygen off before turning the REMstar Pro CPAP System off. This will prevent oxygen accumulation in the room.

WARNING: Oxygen supports combustion. Do not use oxygen in the presence of open flames, cigarette smoke, electrical spark, or other sources of ignition.

Chapter 5: Routine Maintenance

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5.2 Cleaning the System 5-3

5.3 Cleaning / Replacing the Intake Filter 5-3

5.4 REMstar Pro CPAP System Preventive Maintenance Schedule 5-5

Notes:

Chapter 5: Routine Maintenance

5.1 Overview

This chapter provides guidelines and illustrates the cleaning and maintenance procedures for the REMstar Pro CPAP System.

Before cleaning or performing any routine maintenance, always switch the REMstar Pro CPAP Systems's Pressure Start / Stop button to the Stop position and unplug the power cord from the rear of the unit.

5.2 Cleaning the System

WARNING: To avoid electrical shock, disconnect the electrical supply before attempting to clean the REMstar Pro CPAP System. DO NOT immerse the unit in water or allow any liquid to enter the cabinet or the filter intake.

Step 1 Wipe the outside of the unit with a cloth slightly dampened with water and a mild detergent. Let the unit dry before reconnecting the electrical supply.

5.3 Cleaning / Replacing the Intake Filter

The gray pollen filter is a reusable filter that screens out pollens and some household dust. This filter should be cleaned at least once every two weeks under normal usage, or as required, and replaced with a new one every six months. One additional pollen filter is included with the system. The pollen filter must be in place at all times when the unit is operating.

CAUTION: Failure to replace a dirty filter may cause the device to operate at higher than normal temperatures and damage the device.

5.3.1 Removing, Cleaning, and Replacing the Filter

Step 1 With the air flow turned off, disconnect the AC or DC power cord from the back of the unit.

Cleaning / Replacing the Intake Filters (Continued)

Step 2 Remove the filter cap by gently lifting up on the bottom of the filter cap, then pulling it away from the back of the unit.

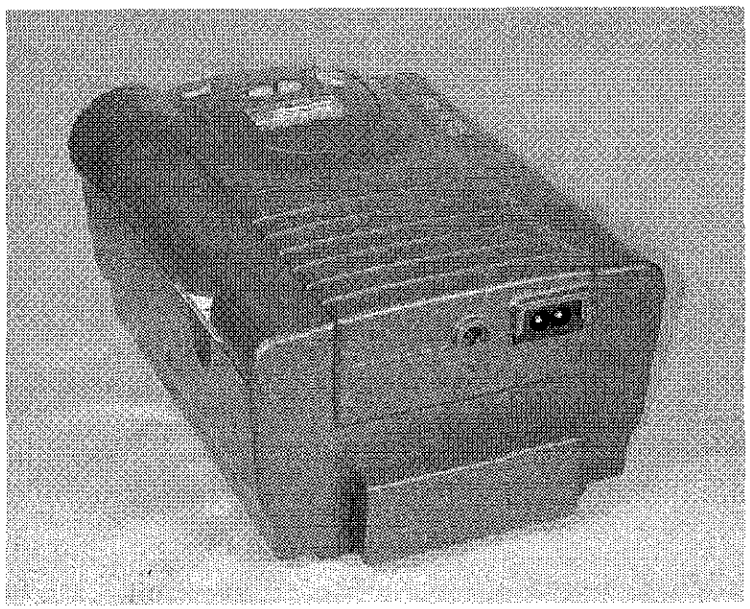

Figure 5-1
Removing the Filter Cap

Step 3 Remove the pollen filter by gently pulling the edges of the filter. Rinse the filter in a steady stream of running water. Squeeze out the water, and repeat. Allow the pollen filter to air dry for 8 to 12 hours, or in a clothes dryer for 15 to 20 minutes.

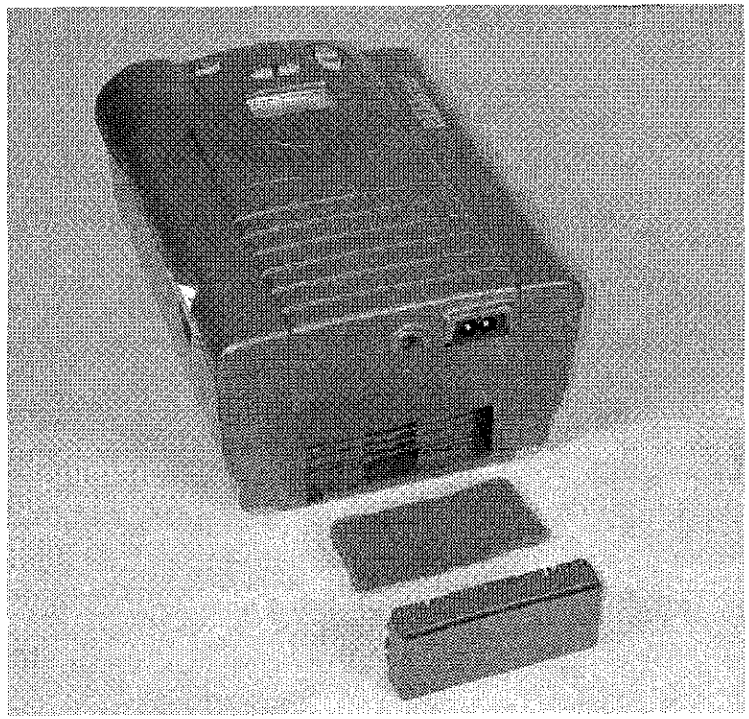

Figure 5-2
The Filter Cap and Filters

Cleaning / Replacing the Intake Filters (Continued)

Step 4 Place the pollen filter into the filter area in the back of the REMstar Pro CPAP System.

CAUTION: The pollen filter must be completely dry before use. Never place a wet filter into the device. Respironics recommends that you clean the filter in the morning and alternate using the two pollen filters provided with the system to ensure enough drying time for the cleaned filter.

CAUTION: DO NOT place both pollen filters into the unit at the same time.

Step 5 Install the filter cap. The opening in the filter cap for the REMstar Pro CPAP System should face down, away from the patient.

5.4 REMstar Pro CPAP System Preventive Maintenance Schedule

The following Preventive Maintenance Schedule lists the items that must be inspected or tested periodically, or after service is performed. Use the Preventive Maintenance Schedule to record the dates on which the maintenance items are performed.

The Preventive Maintenance Schedule may be copied for each unit serviced.

REMstar Pro CPAP System Preventive Maintenance Schedule (Continued)

5.4.1 REMstar Pro CPAP System Preventive Maintenance Schedule (Factory Recommended)

Maintenance Item	Verification Reference	Service Interval	Date
Record Blower Hours	Displayed On Options Screen	As desired.	
Clean / Replace Pollen Filter	Section 5.3.1	Clean every 2 weeks, or as required; Change every 6 months.	
Perform Testing Process	Section 8.1	After service is performed.	
Cleaning	Section 5.2	As required.	

Chapter 6: Trouble-shooting and Diagnostics

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Notes:

Chapter 6: Troubleshooting and Diagnostics

6.1 Overview

WARNING: Electrical Shock Hazard: Disconnect the electrical supply before repairing the unit.

CAUTION: Electronic components used in this unit are subject to damage by static electricity. Use proper static discharge equipment and grounding precautions when servicing the equipment. Service only at a static-free workstation.

This section contains information necessary to troubleshoot and diagnose problems with the REMstar Pro CPAP System. It provides a summary of common system problems as well as a flowchart and table to simplify the troubleshooting process. The error code chart lists all error codes, the associated problem, and suggested corrective action to be taken.

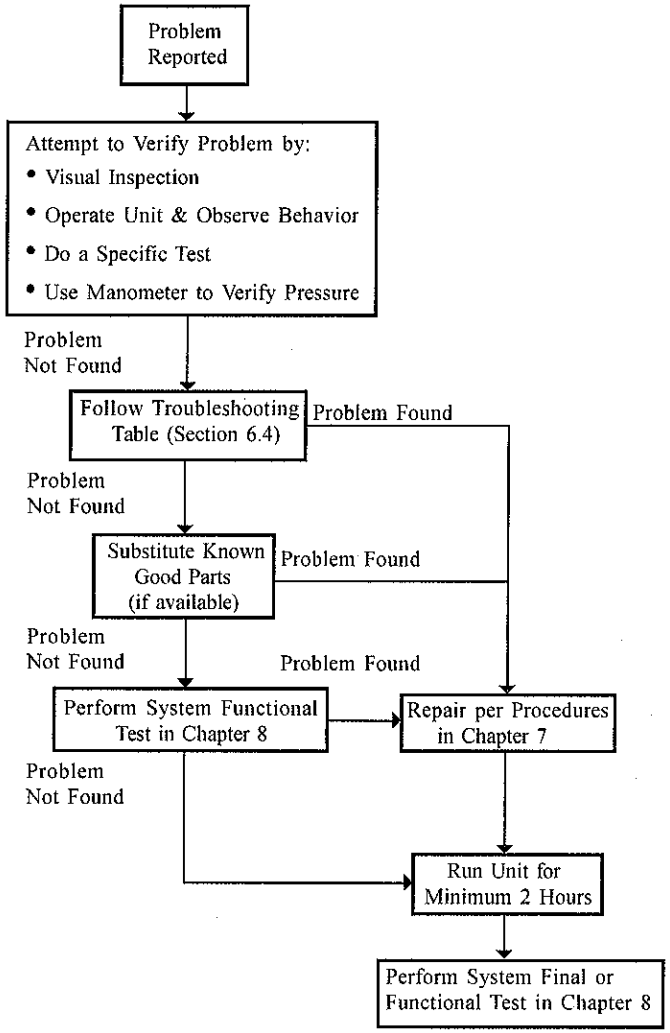
6.2 Common System Level Problems

Screen Message	Description	Result	Corrective Action
Mask Alert	A large circuit leak, such as mask removal, has been detected.	• The audible alarm will sound in approximately 35 - 65 seconds (if the mask alert feature has been turned on). • The air flow will turn off in approximately 45 - 80 seconds (if the auto-off feature has been turned on).	• Press any button on the REMstar Pro CPAP System to silence the audible alarm and clear the display screen. • Check the circuit (flexible tubing assembly, mask) for any leaks and adjust the mask and headgear. • Press the Pressure On / Off button to restart the air flow. **Note:** The audible Mask alarm setting and auto-off feature can be enabled or disabled. (See Section 4.2 - System Setup for instructions.)

Common System Level Problems (Continued)

Screen Message	Description	Result	Corrective Action
Connect Pressure Line	The flexible tubing may have become disconnected from the system.	• The air flow will turn off immediately. • The alert tone will sound. • The back light will flash on and off. • The signal light on the humidifier will turn off.	• Press any button on the unit to silence the audible alarm and clear the display screen. • Reconnect the tubing. • Press the Pressure On / Off button to restart the air flow. **Note:** This alarm setting cannot be turned on or off.
E-XXX	The REMstar Pro CPAP System is not functioning correctly and may need servicing.	• The air flow will turn off immediately. • The alert tone will sound. • The back light will flash on and off. • The signal light on the humidifier will turn off.	• Reset the unit by unplugging the power cord from the electrical outlet and then plugging it in again. • If the message appears again, refer to the Error Code Chart (Section 6.5) for a description of the error and corrective action. **Note:** This alert setting cannot be turned off.

6.3 Troubleshooting Flow Chart


Problem Reported
Attempt to Verify Problem by:
• Visual Inspection
• Operate Unit & Observe Behavior
• Do a Specific Test
• Use Manometer to Verify Pressure
Problem Not Found
Follow Troubleshooting Table (Section 6.4)
Problem Found
Problem Not Found
Substitute Known Good Parts (if available)
Problem Found
Problem Not Found
Problem Found
Perform System Functional Test in Chapter 8
Repair per Procedures in Chapter 7
Problem Not Found
Run Unit for Minimum 2 Hours
Perform System Final or Functional Test in Chapter 8

6.4 Troubleshooting Table

Symptom	Cause	Verification	Corrective Action
Audible Alarm - During audible alarm condition, the alarm is not audible.	Main printed circuit assembly.	Perform power up sequence. Visually verify the LED's and display illuminate. Reestablish original alert conditions. Listen for audible alarm.	• If audible alarm does not work, replace Main PCA. • If visual indicators are not present at power up, perform user interface checkout procedure. • If device fails user interface checkout procedure, replace Main PCA. • If alarm is audible during both tests, no corrective action is required.
Unit does not operate from the 12 VDC power source.	Faulty DC plug, low DC voltage, fuse in DC cord is blown. Main PCA.	Ensure the DC voltage supply is a minimum of 11.5 VDC. Ensure the DC voltage is stable. Monitor the voltage at the back of the DC connector mounted on the Main PCA. If DC voltage is below 11.5 VDC, replace or recharge DC source. If there is no DC measured at the Main PCA, then check the DC adapter cord for continuity.	• If DC source is not at 11.5 VDC or higher, replace or recharge power source as required. • If 12 VDC supply is ok, replace Main PCA.

Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Display Indicator - LED or other indicator not working.	Main printed circuit assembly.	Perform user interface checkout procedure.	• If device fails user interface checkout procedure, replace Main PCA.
Display - Display is blank or contains erroneous information.	Display assembly. Main PCA.	Inspect solder joints between display board and Main PCA.	• Replace Main PCA.
Intermittent Power Supply Problem - An intermittent on / off condition exists, unit alarms randomly, or indicator lights blink sporadically.	Power cord, AC inlet, Main PCA, loose connections.	Inspect power cord for fraying at cable ends. Inspect all connections on the Main PCA.	• Replace Main PCA.
Noise -	Missing or damaged bottom feet on bottom of unit, blower malfunctioning.	Turn over and inspect the bottom for missing or damaged bottom feet.	• If bottom feet are missing, replace bottom enclosure. Tighten any loose screws. • Replace Blower.

Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Odor	Tubing smells new, unit smells new, airborne residue buildup.	Visually inspect patient tubing for contamination.	• Run unit in a clean environment for a few hours to eliminate new smell. Wash tubing with soap and water. To clear residue buildup, replace all subassemblies in the patient air stream (blower filters, patient circuit).
Outlet air temperature - The outlet air temperature is too warm.	Filters dirty, blower, Main PCA.	Ensure the filter is clean and not restricting air flow. Monitor the outlet temperature at the end of the six foot patient tubing. A rise in temperature can be expected (See Section 3.2.1 for Operating Temperature).	Replace in order until solved. • Filters • Blower • Main PCA
Pressure Related Problems - The outlet pressure does not change or properly adjust.	Pressure tubing has been blocked, disconnected, or kinked. Main PCA or blower malfunction.	Inspect pressure tubing for secure connections and kinks. Check blower for leaks.	• Secure pressure tubing connections. • Replace blower, pressure tubing, or Main PCA.

Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Pressure Offset - Static pressure fluctuates from -1.0 cm to +2.0 cm H_2O.	The delivered pressure is higher or lower than the set value by more than -1.0 cm to +2.0 cm H_2O.	Perform power up process.	• Check tubing for kinks. • Replace the Main PCA.
No Stored Therapy Data	SmartCard was not installed in unit prior to use. Not a Respironics SmartCard. Card not formatted or faulty SmartCard.	No therapy data after usage.	• Depress the pressure on / off button before disconnecting the Main AC power.

Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Ramp Pressure - The pressure does not ramp correctly.	No ramp time prescribed. Ramp minimum pressure has to be lower than CPAP pressure. Main PCA. Ramp Button not functioning.	Verify the patients prescription specified ramp. Make sure unit was set for ramp. Perform user interface checkout procedure (see Section 8.1).	• Set unit for ramp. • Replace Main PCA. • If device fails user interface checkout procedure, replace control pad or display PCA.
Pressure Variation - The pressure varies around the set value, pressure fluctuates greater than 1.0 cm H_2O. (This could be normal if the device is in C-Flex mode and in use by the patient.)	Internal air leak. Filters dirty. Main PCA, blower. Air path blocked.	Replace filter. Perform Testing Process (see Section 8.1).	• Replace blower. • If pressure still drifts, then replace Main PCA.

Troubleshooting Table (Continued)

Symptom	Cause	Verification	Corrective Action
Humidifier will not turn on.	Faulty power cord.	Inspect main power cord for fraying at cable ends.	• Replace Power Cord.
	Broken or damaged Light Tube.	Inspect power cord between CPAP and humidifier base.	• Replace Main PCA in humidifier base.
	No infrared connection.	Inspect Light Tube inside CPAP for misalignment.	• Realign or replace light tube.
	Damaged Heater Plate.	Make sure receiver on Humidifier base is not damaged.	• Replace Humidifier Main PCA.
	Humidifier Main PCA.	Inspect Main PCA to see if there is damage to the transmitter on the Main PCA.	• Replace Main PCA.
	CPAP Main PCA.	Make sure CPAP is seated on humidifier base properly.	• Reseat CPAP on humidifier base.
		Inspect Main PCA for damage to the Humidifier On / Off button.	• Replace Main PCA.
		Inspect Heater plate to see that it is connected to the humidifier Main PCA and that it is not damaged.	• Replace Heater Plate in humidifier base.

6.5 REMstar Pro CPAP System Error Code Retrieval

6.5.1 Error Code Retrieval

The REMstar Pro CPAP System stores error codes that may aid the technician in troubleshooting. The following instructions aid in the retrieval of those error codes. The REMstar Pro can store up to 8 error codes at a time. Once this limt is reached the error codes will be overwritten beginning with the first error code.

Step 1 Installing the Software

a. Follow the instructions that are included with the Respironics Utility Software. Included with the instructions are the following:

1. System requirements
2. Intended use
3. Warnings

Step 2 Connecting the REMstar Pro to your Computer

a. Connect the Sleep Link interface card and cable between the REMstar Pro CPAP System and the computer serial port.

b. Connect the REMstar Pro CPAP System to the proper power source.

Step 3 Retrieving the Error Codes

a. With your mouse click on the **Start Button** of your computer.

b. Select:
Programs
Respironics
Tools
Read Error Log

c. The software will load automatically

d. With you mouse click on the Run Arrow ➡ located in the upper left corner of the computer screen.

e. The software will automatically read and display any error codes stored in the unit along with the time the error occured.

Step 4 Closing the Software

a. With your mouse click on **File**.

b. Select:
Exit

Step 5 Disconnect the REMstar Pro CPAP System

a. Disconnect the Power cord and the Sleep Link communication cable from the REMstar Pro CPAP System with C-Flex.

6.6 Error Code Chart

Error Code	Problem	Corrective Action
1	PROM Test - The code in the PROM is corrupt.	Replace Main PCA.
2	RAM Test - The RAM on the Main PCA is not functioning properly.	Replace Main PCA.
3	Stack Test - The Stack memory on the Main PCA is not functioning properly.	Replace Main PCA.
4	Invalid Parameters - A failure has been detected in the nonvolatile memory on the Main PCA.	Reset the parameter by simultaneously pressing the on/off, ramp, and humidifier buttons while reconnecting the power cord. Reset will be displayed on the screen. Then remove power from the device. Reconfigure unit and test for proper operation. If error repeats, replace Main PCA.
5	Parameter Copies - A failure has been detected in the non-volatile memory on the Main PCA or an error occured while calibrating P sensor.	Reset the parameter by simultaneously pressing the on/off, ramp, and humidifier buttons while reconnecting the power cord. Reconfigure unit and test for proper operation. If error repeats, replace Main PCA. Repeat P sensor calibration if error occured during that operation.
6	Watchdog Test - The watchdog in the 68HC16 has failed.	Replace Main PCA.
7	Watchdog Time-out - The system was reset due to a watchdog time-out.	Check for stuck keys under enclosure top. Cycle power to the unit. If error repeats, replace the Main PCA.
8	Key Stuck - One of the keys is stuck in the closed position.	Verify that nothing is pressing a key. Replace control pad. If error persists, replace Main PCA.

Error Code Chart (Continued)

Error Code	Problem	Corrective Action
9	Motor Overspeed.	Replace blower assembly. If error persists, replace Main PCA.
10	Motor Underspeed - The speed of the motor was determined to be below acceptable limits.	Replace blower assembly. If error persists, replace Main PCA.
11	R20 / R21 Corrupt	Replace Main PCA.
12	Motor edge lost.	Check blower wire connections. Replace Blower Assembly. Replace Main PCA.
13	Motor Brake.	Check blower wire connections. Replace Blower Assembly. Replace Main PCA.
14	Motor Current - The motor current has exceeded its limit.	Check blower wire connections. Replace Blower Assembly. Replace Main PCA.
15	Rotor Locked - The motor could not be started.	Check Wiring. Replace Blower Assembly. If error persists, replace Main PCA.
16	Program Sequence - External conditions prevented the proper operation of the software.	Replace Main PCA.
17	Software Error.	Replace Main PCA. Contact Respironics Product Support.
18	A/D Converter	Replace Main PCA.

Error Code Chart (Continued)

Error Code	Problem	Corrective Action
19	DC voltage to low.	Check DC supply voltage. Replace Main PCA.
20	DC voltage to high.	Check DC supply voltage. Replace Main PCA.
21	RTC Dead.	Check Battery for clock. Replace Main PCA.
22	Invalid flow table.	Replace Main PCA.
23	Pressure offset.	Check for leaks or kinked internal tubing. Replace Main PCA.
24	Flow offset.	Check for leaks or kinked internal tubing. Replace Main PCA.
25	Pressure line loss.	Check for leaks. Replace Main PCA.
26	Unknown interrupt.	Replace Main PCA.
27	Invalid hardware flags.	Replace Main PCA.
28	Motor edge extra.	Check blower wire connections. Replace Blower Assembly. Replace Main PCA.
29	Motor current on high.	Replace Main PCA.
30	Motor VcenterEst. Bad.	Replace Main PCA.
31	Invalid error.	Replace Main PCA. Contact Respironics Product Support.

6.6 SmartCard Error Code Chart

Error Code	Problem	Corrective Action
1	Read Fail - Card orientation is wrong.	Re-enter the SmartCard. If error still persists, replace SmartCard.
2	Invalid card type - orientation is wrong or wrong card.	Re-enter the SmartCard. If error still persists, replace SmartCard.
3	Invalid Card Format - Information on SmartCard is incorrectly entered.	Place the SmartCard in the Reader/ Writer and re-enter the information back onto the SmartCard.
4	Unit in Dealer Mode.	Remove power from the Respironics CPAP System. Reconnect power to unit without pressing any keys.
5	Unit in Calibration Mode.	Remove power from the Respironics CPAP System. Reconnect power to unit without pressing any keys.
6	Invalid Card ID Block. The checksum in the SmartCard ID block is invalid.	Remove and / or replace SmartCard.
100	Prescription Block Checksum Failure.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
101	Prescription Version Error.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
102	Invalid Unit. The unit is not capable of the specified prescription.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
103	Prescription Format Error. Software cannot under stand the format of the prescription.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.

SmartCard Error Code Chart Continued

Error Code	Problem	Corrective Action
104	Prescription Invalid - The unit has no knowledge of the prescription entered.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
105	Prescription parameter out of range.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
200	Invalid Card Data Control Block.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
201	Invalid Card Data Control Block.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
202	Card Data Control Block Check Error.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
203	Control Blocks Invalid.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
300	Invalid UIDB Version.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.
301	UIDB Block Check Error.	Use the SmartCard Wizard in Encore 3.0 or higher to format the SmartCard.

Chapter 7: Repair & Replacement

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Notes:

Chapter 7: Repair & Replacement

7.1 Overview

Figure 7-1 lists the names and identifies the locations of the replaceable components in the REMstar Pro CPAP system. This provides a quick reference and overview of the unit. Within each replacement section, more detailed support information is provided to illustrate the exact component location and replacement procedure(s).

For technical assistance or replacement part ordering information contact Respironics Corporate Technical Service.

U.S. and Canada

Phone: **1-800-345-6443**
Fax: **1-888-886-0245**

International

Phone: **001-724-387-4000**
Fax: **001-724-387-5012**

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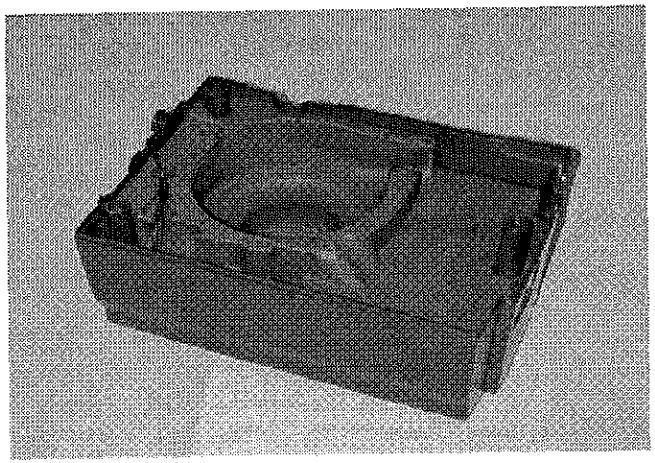
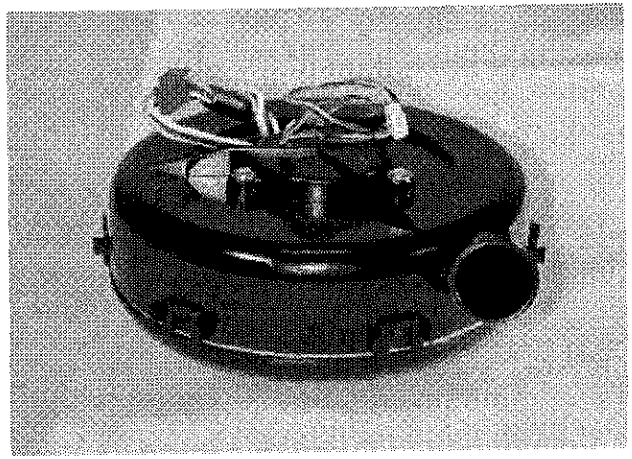
www.respironics.com

service@respironics.com

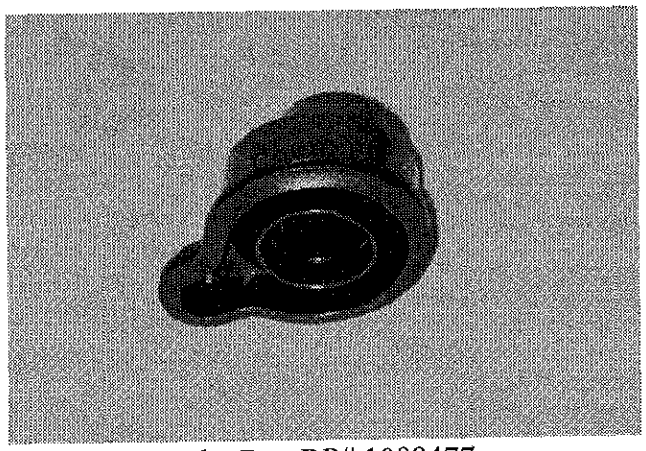
7.2 REMstar Pro CPAP System Repair Kits



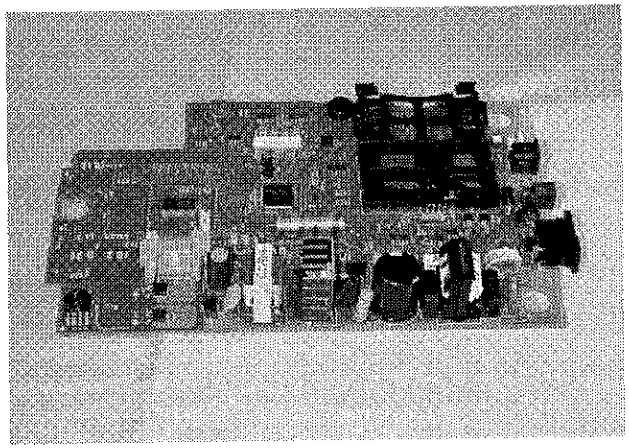
Bottom Enclosure RP# 1011929* (see note* page 7-8)



Blower Assembly RP# 1011213



Outlet Port RP# 1008477



Main PCA RP# ** (see note** page 7-8)